Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Maritimes Region
Canadian Science Advisory Secretariat
Science Advisory Report 2007/027

RECOVERY POTENTIAL ASSESSMENT FOR RIGHT WHALE (WESTERN NORTH ATLANTIC POPULATION)

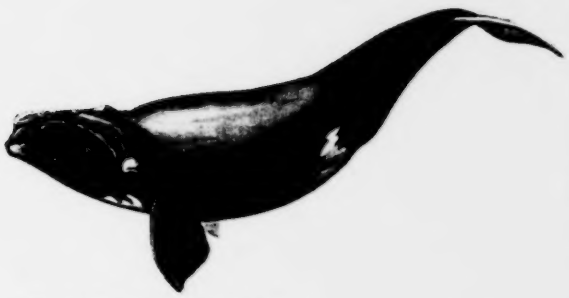

Illustration by Scott Landry

Source : Canadian Whale Institute

Figure 1: Range of western North Atlantic right whale in Canadian waters (shaded area). Filled boxes identify the right whale Conservation Areas.

Context

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) evaluated the status of the right whale in 1980, and designated the species status as Endangered. At the time, the right whale was considered a single species. COSEWIC re-examined and confirmed the status of right whale as Endangered in April 1985 and again in April 1990. In 2003 the right whale was divided into two species, which resulted in separate Designatable Units for the North Atlantic right whale (Eubalaena glacialis) and the North Pacific right whale (E. japonica). North Atlantic right whale was designated Endangered by COSEWIC in May 2003 and added to Schedule 1 of SARA as Endangered in 2005. As reasons for designation COSEWIC noted that the species was heavily reduced by whaling, the total population numbered about 322 animals as of 2003 (about 220-240 mature animals), and is experiencing high mortality from vessel strikes and entanglement in fishing gear.

SUMMARY

- Population abundance is critically low, numbering approximately 325-350 individuals through 2003. The best available population model indicates a declining trend in abundance over the period of 1980-1995. If the 1995 growth rate was maintained, the population model predicts an average time to extinction of about 200 years.

Canada

- Critical Habitat includes areas of concentrations of right whale prey, especially stage C5 *Calanus finmarchicus* copepodites, and the environmental, oceanographic and bathymetric conditions that aggregate right whale prey at interannually predictable locations.

- Grand Manan Basin matches the characteristics of Critical Habitat by supporting the highest concentrations of copepods in the Bay of Fundy. The topography and movement of water masses in Grand Manan Basin concentrate the resident copepod population. Whether or not Roseway Basin serves as additional critical habitat could not be determined with confidence since detailed information concerning prey concentrations is not available.

- The recommendation for an interim, science-based recovery target for right whale population abundance is, "An increasing trend in abundance over three generations". Generation time for right whale is approximately 20 years; therefore the minimum time period necessary to achieve this target is around 60 years.

- Western North Atlantic right whales do not occupy residences as defined under SARA.

- There is no scope for allowable human-induced mortality, since population abundance is estimated as critically low and the population appears to be declining toward extinction.

- The two major known threats to right whale survival are vessel strike and entanglement in fishing gear. These two threats account for all known human-induced mortality. Other potential threats have been identified, but their effect on right whales is uncertain.

BACKGROUND

Rationale for Assessment

The Species at Risk Act (SARA) provides legal protection to species listed in Schedule 1 including the western North Atlantic right whale. Under SARA it is prohibited to kill, harm, harass, capture or take an individual of this population and also to destroy any part of its critical habitat. Section 73 of SARA authorizes competent Ministers to permit otherwise prohibited activities affecting a listed wildlife species, any part of its critical habitat, or the residences of its individuals if certain preconditions are met. Examples of such activities include research in support of recovery efforts, eco-tourism (whale-watching), and by-catch in commercial fisheries. A recovery strategy, and subsequently an action plan, is required for all wildlife species listed in Schedule 1 as threatened, endangered, or extirpated.

Decisions made on permitting of harm and in support of recovery planning need to be informed by the impact of human activities on the species, alternatives and mitigation measures to these activities, and the potential for recovery. An evaluation framework, consisting of three phases (species status, scope for human–induced harm, and mitigation) has been established by DFO to allow determination of whether or not SARA incidental harm permits can be issued. The analysis provided herein will inform issuance of incidental harm permits and recovery planning. In the context of this status report, "harm" refers to all prohibitions as defined in SARA.

Historical Whaling

The North Atlantic right whale was the first whale species to be commercially exploited, and it played a large role in the development of the whaling industry. Whaling for right whales in the western Atlantic may have been undertaken by Basque whalers during the 16th and 17th centuries during their hunt for bowhead whales in the Strait of Belle Isle. In the US, the same population was the target of coastal whaling during 18th, 19th and early 20th centuries. As a consequence, the population was reduced to very low levels by the beginning of the 1900s. Harvest of right whales has been banned internationally since 1935.

Species Biology and Ecology

The western North Atlantic right whale (*Eubalaena glacialis*) is a large baleen whale (up to 16 metres, females a metre longer, adults weigh about 70 tonnes), generally black in colour with occasional white belly patches and no dorsal fin.

Calving grounds are located in the southern (Florida, Georgia), winter portion of the range, and almost all of the sightings at this time and area are of females and their calves. Where males and non-pregnant females overwinter is unknown. Late winter and spring feeding aggregations of right whales are observed in Cape Cod Bay Massachusetts Bay and the Great South Channel. In Canadian waters, concentrations of foraging right whales are seen in the Bay of Fundy and Roseway Basin (southwestern Scotian Shelf) during the summer and autumn. Much smaller numbers of whales are seen in other areas, such as the Gaspé region of the Gulf of St. Lawrence; however sighting effort is much lower in these areas. By late autumn, most right whales begin to disperse to wintering areas, although there have been sightings of right whales in the Bay of Fundy as late as December, and right whale vocalizations have been detected on Roseway Basin as late as December.

Data on longevity are not available, but the oldest individual on record is estimated to have been 70 years old when last seen. Females are seen with their first calf at approximately nine years of age. Age at maturity for male right whales has not been determined. The sex ratio is approximately 50/50.

Right whales give birth to a single calf. The mean interval between births was 3.7 years with a range of 2-7 years. In the 1990s, the mean calving interval increased significantly to nearly 6 years, and recently returned to levels observed previously. It has been estimated that 26% to 31% of the population are juveniles (< 9 years of age), significantly lower than the level observed in some other baleen whales.

North Atlantic right whales require a concentrated source of zooplankton (usually copepods) with relatively high energy content in order to meet feeding requirements. In Canadian waters, right whales are thought to feed primarily on the calanoid copepod, *Calanus finmarchicus*, especially on the diapause copepodite C5 stage. This species is the most abundant copepod on the Scotian Shelf and in the Bay of Fundy. The C5 stage exhibits relatively large energy stores in the form of high-energy lipids.

RECOVERY POTENTIAL ASSESSMENT

Population Status and Trajectory

Based on photo-identification information, the best estimates of minimum population abundance range between 325-350 individuals. The adult population likely ranges from 220-240 individuals, as of 2003. Population models indicate a declining trend in abundance over the period of 1980-1995. If the 1995 growth rates are maintained, the population is at high risk of extinction within 200 years. Declining survival coupled with high variability in reproduction has limited population growth over the last 25 years. Increasing mortality of breeding females is of particular concern, and may have driven the decline in population growth rate to levels below replacement.

Right whales currently occupy nearly the full extent of their known historical range in the western North Atlantic.

Critical Habitat

Critical Habitat for right whale in Canadian waters must allow successful feeding to ensure that sufficient energy reserves are accumulated to support the energetic cost of basal metabolism, growth, reproduction, and lactation. Critical Habitat has to provide this level of foraging success for right whales on a predictable, interannual basis. Given what is known about prey preference of right whales and the distribution of their prey, a fairly robust description of generic Critical Habitat for right whale can be proposed. Critical Habitat includes concentrations of right whale prey, especially stage C5 *Calanus finmarchicus* copepodites, and the environmental, oceanographic and bathymetric conditions that aggregate right whale prey at interannually predictable locations.

Grand Manan Basin matches the characteristics of Critical Habitat described above by supporting the highest concentrations of copepods in the Bay of Fundy. The edges of Grand Manan Basin lie at about 100 m depth, and the maximum depth of the central Basin is approximately 200 m. The area is exposed to strong tides. The topography and movement of water masses in Grand Manan Basin concentrate the resident copepod population.

Every year the Basin area is frequented by a substantial number of the right whales, and in some years up to two thirds of the known population have been sighted in this region. Many females with calves have been sighted in the Bay of Fundy, and a portion of these right whale mothers regularly bring calves to the Bay. Much of the research concerning right whale habitat that has occurred in Canadian waters has been undertaken in and around Grand Manan Basin.

Roseway Basin, on the southwestern Scotia Shelf, is another important area of right whale aggregation wherein right whales have been observed feeding and socializing. Mother-calf pairs have been seen in the area, but are rare. Whether or not this area can be defined as Critical Habitat could not be determined with confidence since detailed information concerning prey concentrations is not available.

Targets for Recovery

Recovery target for abundance

There are no firm estimates of historical population abundance, but rough estimates are available from two sources. Analyses of harvest data from whaling records provide estimates of historical population abundance of less than 10 000 whales. Genetic analyses suggest that historical abundance may have numbered in the hundreds to the thousands.

The lack of firm estimates of historical abundance means that a long-term target cannot yet be determined. However, current knowledge of the status and trends in this population can be used to develop interim targets until the issue of historical abundance is resolved.

The recommendation for an interim, science-based recovery target for right whale population abundance is, "*An increasing trend in population abundance over three generations*". The current abundance is dangerously low and the best estimate of population growth rate is negative (see above). There is an immediate requirement to reduce the probability of extinction through fostering positive population growth rates and increasing abundance. It is difficult to provide firm recovery targets for right whales because a clear threshold for abundance that would ensure their long-term survival is not known. Nevertheless, it is important to state a desirable (positive) trend in population growth in order to provide a context for the development and implementation of recovery measures and research activities.

Generation time in western North Atlantic right whale is approximately 20 years. Therefore given an interim recovery target of "*An increasing trend in population abundance over three generations*", the minimum time period necessary to achieve this target is around 60 years.

Recovery target for distribution

Right whales occupy nearly the full extent of their known historical range in Canadian waters. Therefore, a recovery target defined in terms of population distribution is maintenance of a broad distribution.

Critical Habitat

There is no evidence to suggest the amount of available Critical Habitat is limiting right whales from reaching the recovery targets described above.

Residence Requirements

Section 2(1) of SARA defines a residence as a "dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating". Western North Atlantic right whales do not occupy residences as residences are defined under the Act.

Allowable Human-induced Mortality

It was determined that scope for allowable human-induced mortality does not exist, since population abundance is estimated as critically low, the population appears to exhibit a declining trend toward extinction, and the mortality rate of a key life stage (adult females) appears to have increased between 1980 and 1995.

The population has to stabilize (cease declining) first. What level of non-lethal harm may be permissible is not apparent and nearly impossible to evaluate with confidence. Any level of non-lethal harm that may impede population productivity would put recovery at risk, given the population's trajectory toward extinction.

Threats and Limiting Factors

Vessel strike and entanglement

The two major sources of human-induced mortality throughout the range to right whales are vessel strike and entanglement in fixed fishing gear. These two threats account for all of the known human-induced mortality. For the period of 1970 to October 2006, 73 known mortalities have been documented. Of these mortalities, eight were caused by entanglement in fishing gear, 27 were due to vessel strikes, 21 were of undetermined causes, and 17 mortalities were of calves where the cause of death could not be linked to entanglement or vessel strike. In addition, from 1986 to 2005 there were 61 confirmed reports of entanglements, including the known entanglement mortalities listed above. In addition to direct mortality, it is possible that whales surviving vessel strike and entanglement episodes may suffer negative effects such as reduced fertility. Seventy-five percent of all living right whales have scars consistent with entanglement or vessel strike, and scarring rates may have increased during the 1990s.

Estimates of human-induced mortality due to both vessel strike and entanglement in fishing gear are underestimates of the actual impact of these activities. Whales struck in offshore areas may never be sighted due to low search effort. It is suspected that chronically entangled animals may sink upon death, due to loss of buoyancy from depleted blubber reserves, and therefore escape detection. A second reason for underestimation is that entangled whales may not be detected if their remains remain subsurface in the entangling gear.

Other potential threats to right whales

Although vessel strike and entanglement in fixed fishing gear account for all known human-induced mortality, a number of additional potential threats to right whales and their critical habitat have been identified. However, much less information exists to evaluate those threats. Potential threats can be grouped in several categories that include noise, vessel disturbance, contaminants, and environmental or habitat change. A range of human activities might cause such effects (Table 1). Direct studies have not been undertaken to investigate the effects of noise on right whales, but potential effects include habituation, behavioural changes, temporary or permanent hearing impairment, acoustic masking, and even mortality. To date no cases of contaminants affecting the survival or reproductive success of right whales have been documented. However, it is possible that due to occupancy of coastal areas right whales may be exposed to contaminants from run-off, sewage outflows or other sources. Vessel activity might affect the whales' behaviour (e.g. disturb feeding or nursing) or displace whales from rich

food patches, but to date the potential effects of vessel disturbance have not been evaluated. The potential effects of environmental change are uncertain.

Threats to critical habitat would likely have to degrade prey productivity and quality, alter the oceanographic and bathymetric features that lead to prey aggregation, or exclude whales from the area of critical habitat.

Table1: Documented and potential threats western North Atlantic right whales and their Critical Habitat in Canadian waters ("D": threat affects whales directly; "CH": threat affects Critical Habitat).

	Documented	Potential
Imminent or Occurring	Vessel strike (D) Entanglement in fishing gear (D)	Vessel noise (CH) Seismic surveys (CH) High energy, mid-frequency sonar (D) Oil and gas development (CH) Vessel proximity/disturbance (D)
Hypothetical (may or may not be occurring at present)		Energy development using tidal or current sources (CH) Invasive species (predate on or compete with right whale prey) (CH) Contaminants/pollution (D, CH) Changes in food supply (D, CH) Climate change(D, CH)

Sources of Uncertainty

Survey effort for right whale abundance and distribution is concentrated in several relatively small areas and during the months of summer and early autumn. Large portions of the historical range are not well-surveyed. Summer and autumn patterns of habitat use are currently unknown for up to one half of the population.

Estimates of prey concentration and distribution on the required fine-scale resolution of relevance to right whale foraging are available only for Grand Manan Basin. This limits the ability to estimate the amount and locations of other critical habitat.

There is undocumented mortality.

CONCLUSIONS AND ADVICE

Population abundance is critically low, numbering approximately 325-350 individuals through 2003. The best available population model indicates a declining trend in abundance over the period of 1980-1995. If the 1995 growth rate was maintained, the population model predicts an average time to extinction of about 200 years.

Critical Habitat includes concentrations of right whale prey, especially stage C5 *Calanus finmarchicus* copepodites, and the environmental, oceanographic and bathymetric conditions that aggregate right whale prey into interannually predictable aggregations.

Grand Manan Basin matches the characteristics of Critical Habitat. The highest concentrations of copepods in the Bay of Fundy are located in Grand Manan Basin. The topography and movement of water masses in Grand Manan Basin concentrate the resident copepod population. Whether or not Roseway Basin can also be defined as additional Critical Habitat could not be determined with confidence since detailed information concerning prey concentrations is not available.

The recommendation for an interim, science-based recovery target for right whale population abundance is, "*An increasing trend in abundance over three generations*". The current abundance is dangerously low and the best estimate of population growth rate is negative. Generation time in right whale is approximately 20 years; therefore the minimum time period necessary to achieve this target is around 60 years.

There is no scope for allowable human-induced mortality, since population abundance is estimated as critically low, the population appears to exhibit a declining trend toward extinction, and the mortality rate of a key life stage (adult females) appears to have increased during the period of 1980-1995.

The two major known threats to right whale survival are vessel strike and entanglement in fishing gear. These two threats account for all of the known human-induced mortality. Other potential threats have been identified, but their effect on right whales is uncertain.

SOURCES OF INFORMATION

Smedbol, R.K. 2007. Recovery Potential Assessment of western North Atlantic right whale (*Eubalaena glacialis*) in Canadian waters. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/044.

COSEWIC 2003. COSEWIC assessment and update status report on the North Atlantic right whale *Eubalaena glacialis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 28 pp.

Fujiwara, M., and Caswell, H. 2001. Demography of the endangered North Atlantic right whale. Nature 414: 537-541.

FOR MORE INFORMATION

Contact: Dr. R. Kent Smedbol
Fisheries and Oceans Canada | Pêches et Océans Canada
Biological Station | Station Biologique
531 Brandy Cove Rd | 531 rue Brandy Cove
St. Andrews, NB E5B 2L9 | St. Andrews, N-B E5B 2L9
Tel: (506) 529-5976
Fax: (506) 529-5862
E-Mail: Smedbolk@mar.dfo-mpo.gc.ca

This report is available from the:

Canadian Science Advisory Secretariat
National Capital Region
Fisheries and Oceans Canada
200 Kent Street
Ottawa, ON K1A OE6

Telephone: (613) 990-0293
Fax: (613) 990-2471
E-Mail: CSAS@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1480-4913 (Printed)
© Her Majesty the Queen in Right of Canada, 2006

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2007. Recovery potential assessment for right whale (Western North Atlantic population). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/027.